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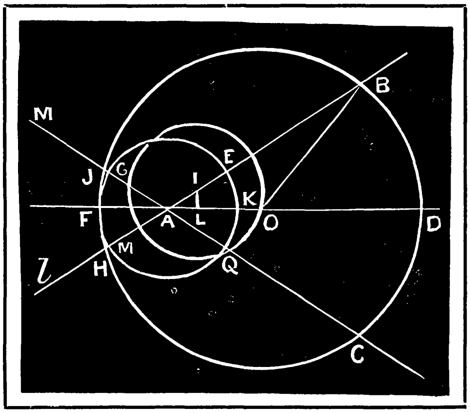
Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

Let 2θ be the angle formed by l, m. Also let A be the origin. Then $(\frac{1}{2}r\cos\theta,\ \frac{1}{2}r\sin\theta)$ are the coördinates of I where FD is the axis of abscissas.



$\therefore x^2+y^2-rx\cos\theta-ry\sin\theta=\frac{3}{4}r^2$ is the equation to the circle, center I.

$\therefore y^2-ry\sin\theta=\frac{3}{4}r^2$ or

$$y=\tfrac{1}{2}r\sin\theta\pm\tfrac{1}{2}\sqrt{(3r^2+r^2\sin^2\theta)}.$$

$\therefore OD=OA+r=y+r=r[1+\frac{1}{2}\sin\theta+\frac{1}{2}\sqrt{(3+\sin^2\theta)}]$.

Then if $\angle BOD=\phi$,

$$AO:BO=\sin(\phi-\theta):\sin\theta.$$

$$\therefore\sin(\phi-\theta)=\frac{[\sin\theta+\sqrt{(3+\sin^2\theta)}]\sin\theta}{2+\sin\theta+\sqrt{(3+\sin^2\theta)}}$$

This gives ϕ. Now $\text{arc}HFJ:\text{arc}BD=2\theta r:\phi DO$.

$\therefore\text{arc}HFJ:\text{arc}BD=2\theta:[2+\sin\theta+\sqrt{(3+\sin^2\theta)}]\phi$.

265. Proposed by R. D. CARMICHAEL, Hartselle, Ala.

Find the Cartesian equation of a curve in a vertical plane such that a particle, sliding down the curve under the force of gravity alone, will require to pass from any point of beginning to the lowest point of the curve, a time proportional to the square of the distance to be traversed along the curve.

Solution by PROFESSOR WILLIAM HOOVER, Ph. D., Athens, Ohio.

With the usual notation, the equation of motion is

$$\frac{ds^2}{dt^2}=2gy\,\ldots\ldots\ldots(1).$$

Let $t=ks^2$, or $s\sqrt{k}=\sqrt{t}$ ....(2). This gives

$$\frac{d^2s}{dt^2}=\frac{1}{4kt}=\frac{1}{4k^2s^2}=2gy\,\ldots\ldots\ldots(3),\text{ or, } s=\frac{1}{2k\sqrt{2g}\sqrt{y}}\,\ldots\ldots\ldots(4).$$

Differentiating, $ds=-\dfrac{1}{4k\sqrt{2g}}\cdot\dfrac{1}{y^{\frac{3}{2}}}$ ....(5). But $dx^2+dy^2=ds^2$ ....(6).

Substituting (5) in (6), and arranging,

$$dx=\frac{\sqrt{(1-16k^2gy^3)}}{4k\sqrt{g}\,y^{\frac{3}{2}}}dy,$$

the differential equation of the curve, cartesian coördinates.

Also solved by G. B. M. Zerr. Professor Greenwood derives the *intrinsic* equation in the simple form $k^2=4s^3g\cos\phi$.